search light which renders them visible is an invaluable assistant. A year ago some accounts were published relative to the cloud effects on Mount Low and Pasadena. According to these accounts Mount Low is about 15 miles north-northeast from Los Angeles and about 6 miles in a straight line from Pasadena. When the beam of light fell upon the bodies of clouds they at once became luminous, so that all the details of motion were visible; when the beam fell upon the falling rain the great cone of light glowed like molten metal. Distant clouds moving up the canyons were searched out and made to glow as if in the midday sunshine. It seems as if the formation and motion of fog and cloud at nighttime could be advantageously studied by means of the search light. The height at which fog first forms, and its gradual extension upward and downward during the night, would be a very interesting and profitable investigation.

WATERSPOUTS OFF LONG ISLAND.

On April 9 when the schooner *George M. Grant* was within a few knots of Montauk Point, the sea, which had been heavy all along the Long Island coast from Fire Island, rapidly became the roughest that Captain Pelton had ever seen. It was about eight bells, or 4 p. m., and thick weather had prevailed all day. During a temporary lift in the clouds Captain Pelton and his crew saw ahead four immense waterspouts. Three of them were at a comfortable distance, but the fourth passed by to starboard not an eighth of a mile from the schooner. Captain Pelton says that the noise made by the spout as it whirled by the vessel was like that made by an immense cornsheller.

WATERSPOUT, CLOUDBURST, OR TORNADO.

These three terms are often used indiscriminately when it would be easy to make a clear distinction between them. The Cleveland World of April 1 reports that "a waterspout on March 31 at Pana, Ill., threw a train of five cars and engine from the track of the Illinois Central." It does not appear likely that the damage here mentioned was done by wind; we may, therefore, infer that we have not to do with a tornado. A waterspout at sea is, according to all established usages in the English language, a different phenomenon from a heavy rain. Rain often accompanies a waterspout, but is not the prominent and characteristic feature. In the present case there could have been no waterspout properly speaking because the phenomenon occurred over the dry land of the interior of the continent. The daily weather map shows that the conditions were favorable for the formation of severe rains, thunderstorms, cloudbursts, and possibly tornadoes over Illinois on the afternoon of March 31; in fact a tornado was reported in Arkansas, but not waterspouts properly so-called. The use of the word "waterspout," when the writer really means only a heavy rain and wind, is not to be recommended. Such rains and winds are characteristic of thunderstorms and so-called "cloudbursts." In the present case it is likely that rain did not alone do the damage that is reported; a flooded track and a strong current of water would be needed to throw an engine from the track, or possibly the flood caused by the rain had undermined the track and thus indirectly caused the derailment. In general, in such cases as this it would be more proper to omit the words "waterspout" and "cloudburst." If the train was thrown from the track, or lifted from the track, as the headlines of the above article had it, this must have been due to a severe storm, but certainly not to a "waterspout" properly so called.

THE CHARACTER OF THE SKYLIGHT.

It is generally recognized that the influence of the sunlight and diffused skylight on the assimilation and growth of plants is brought about, first, by the heat that warms the earth and promotes the rise of the sap and, second, by the chemical action that is brought about by certain portions of the solar spectrum or more properly by radiations of specific wave lengths which fall upon the leaves of the plants and determine the formation of chlorophyll. When plants are cultivated under the influence of artificial lights, or in portions of the earth where the sunlight is obscured by cloud and fog, their development is usually slower, and they oftentimes fail altogether to produce a satisfactory sap or crop, or mature seed. This failure is reasonably attributed to the nature of the light and especially to the relative abundance of the radiations that produce favorable chemical changes as compared with those that produce undesirable changes. Any investigation into the influence of climate on plants and crops and any effort to cultivate plants by artificial light must take into account the relative energies transmitted in different portions of the spectrum. This distribution of energy with wave length is extremely irregular when the flame is produced by burning simple substances, as is shown by the fact that the spectrum is generally a series of alternating bright and dark or warm and cold spaces, but is much more regular when the radiation emanates from incandescent masses of solids before they evaporate into the gaseous condition. The distribution of energy throughout the spectrum is also greatly affected by the reflection from any surface; especially is this true in the case of the blue light of the sky, which is apparently a species of selective reflection from the minutest particles of aqueous vapor and which, notwithstanding its visual feebleness, is yet a matter of the greatest importance to agriculture. The total amount of energy received by any plant from the whole vault of the blue sky will in hazy weather equal that received directly from the sun and in the case of a thin layer of cloud or fog when the sun is invisible and the direct radiation therefore zero, the indirect diffused radiation may still be a large quantity. This latter consideration suffices to explain why many plants flourish in a foggy and cloudy climate and in shady places where the direct sunlight never penetrates.

The total energy involved in the molecular vibrations that constitute radiation is not shown by its effect in producing light or heat or chemical actions; these are but some of the modes in which a portion of that energy becomes appreciable to us. This radiant energy is conveyed from point to point by the mediation of the ether, and the ether can only become appreciated by its action on the so-called ponderable matter. It is probable that the energy involved in the movements of the ether is far greater than that which is made measurable by its visual, chemical, or thermal results, for there are still other results accomplished by it, as shown by the phenomena of electricity, magnetism, and gravitation.

The following table is quoted from a paper in the *Annalen der Physik und Chemie*, Vol. LIII, by Koettgen, who has measured the relative intensity of the light in the different parts of the spectrum from a large variety of lamps and burning substances. Her measures of the sunlight and skylight particularly interest the meteorologist and agriculturist. They were made in the first half of August, 1893, near Berlin, Germany, in latitude N. 52°. At this season and place the maximum midday altitude of the sun varies from 56° on August 1 to 52° on August 15. The measurements were made by directing the vision toward the blue skylight at a considerable altitude above the horizon, and probably in the northern portion of the sky, although that is not specifically stated. The results are given in the first column. When directed toward an overcast sky covered by an apparently uniform thickness of cloud, the measurements given in the fourth column were obtained, and when directed toward the shining white side of a cumulus cloud, those in the fifth column. When directed toward the sun itself, the measurements given in the sixth and seventh columns were obtained. The figures given in these columns express the relative ability of different sources of light to produce light of a specific wave length; thus, for instance, if a Heffner lamp, which was used by Miss Koettgen as the standard, should at the yellow wave length 590, give the same intensity as the blue sky, then at the wave length 430, the blue sky would give a violet light that is 61.63 times as intense as the violet light of the Heffner lamp at that point of the spectrum. The author used the spectrum photometer invented by Dr. Arthur Koenig, and the table expresses visual results, and may not apply strictly to chemical or thermal results.

Wave length.	Spectrum color.	Blue sky-light.	Overcast sky.	Bright cloud.	Direct sunlight.	
Microms.						
690	Red.	0.21	0.25	0.37	0.31	0.30
670	Orange.	0.30	0.33	0.46	0.36	0.39
650	Orange.	0.40	0.43	0.56	0.45	0.48
630	Yellow.	0.53	0.57	0.69	0.60	0.62
610	Yellow.	0.74	0.76	0.82	0.79	0.80
590	Yellow.	1.00	1.00	1.00	1.00	1.00
570	Yellow.	1.58	1.57	1.56	1.34	1.34
550	Olive.	2.32	2.24	2.14	1.87	1.86
530	Green.	3.49	3.22	2.95	2.54	2.58
510	Green.	5.75	4.82	4.30	3.68	3.63
490	Blue.	9.41	7.39	6.65	5.56	5.48
470	Blue.	18.17	13.34	11.87	8.65	8.79
450	Blue.	33.95	24.53	19.85	....	13.60
430	Violet.	61.63	36.52	30.73	19.18	19.74

ATMOSPHERIC VAPOR.

The relation between the air and the moisture that it contains is very frequently stated incorrectly in elementary text books on physics and in ordinary popular explanations of meteorological phenomena. The error consists essentially in the idea attached to absorption, as in the sentence "a cubic foot of free air at a temperature of 50° will absorb 4.28 grains of aqueous vapor." This reads as though the writer considered the air in the same light as a sponge. Now, a sponge absorbs water by virtue of its own structure, and if the sponge were not in place the water would not leave its former position in order to ascend into the sponge. It is not so with air. The vapor of water ascends into the air by virtue of certain inherent properties of its own to which the air offers a slight resistance; if the air were absent from a cubic foot of space the vapor would still fill that space. The above quotation should, therefore, read as follows: A cubic foot of space, if saturated at a temperature of 50°, will contain 4.28 grains of aqueous vapor.

It takes a little time for aqueous vapor to diffuse into and thoroughly saturate a given cubic foot of space. It takes a little more time if that space already has air in it, but when the space is finally saturated the amount of the vapor is, so far as can be measured, appreciably the same, no matter whether the air is present or not. We must, therefore, speak of the vapor and the air as coexisting side by side, and it is no more proper to speak of the air as having absorbed the vapor than to speak of the vapor as having absorbed the air.

Owing to the mutual resistance of the air and vapor the molecules of the one do not pass through and among those of the other as freely as they pass through empty space. This gives rise to what is called the coefficient of diffusion or the time required for a unit volume of either gas to completely interpenetrate a unit volume of the other. The time required for this mutual interpenetration is also, of course, the time required for the mutual separation after they have been mixed together. As this time is quite appreciable it follows that both the air and the vapor move along together either horizontally, as wind, or vertically, as in the ascending currents that make clouds. Of course, in such a mixture the temperature of the air and the vapor are precisely the same, and we can not warm or cool one without warming or cooling the other.

If by any process the temperature is lowered below the saturating temperature of 50° F. then the cubic foot of space can not contain so much as 4.28 grains of aqueous vapor and the difference, whatever it may be, must be condensed into particles of water, forming haze, fog, clouds, rain, etc. The cooling just referred to is often brought about by the mere act of expansion as the warm moist air rises in the atmosphere. This expansion implies that work has been done in the interior of the mixture of air and vapor. A mass of perfectly dry air or a mass of perfectly pure vapor would cool by expanding just as the mixture does, but at ordinary temperatures the cooling of the dry air will not convert it into liquid air, whereas the cooling of aqueous vapor can easily convert it into liquid water. We have seen it stated that when the air expands it is, in this rarefied condition, not able to absorb so much aqueous vapor as in its former unexpanded or denser condition. But this is a mistake. Rarefied air at ordinary temperatures in the laboratory will hold as much vapor as denser air at the same temperature. The reason why rarefied air on mountain tops does not ordinarily contain as much vapor as the denser air at the base of the mountain is that the mountain air is cooler; it is the temperature and not the pressure that regulates the quantity of moisture in the upper strata of the atmosphere.

THE METEOROLOGICAL USE OF THE TERM "LOCAL."

The adjective "local" in the expressions "local rain," "local storm," "local wind," "local frost," etc., seems to require some special definition, so that the word may be used in a fairly uniform sense by all meteorologists. As preliminary to any attempt at a definition it will be best to collect together a few examples illustrating the wide range of ordinary usage.

The storm of September 6, 1895, in Oklahoma County, Okla., is stated in the Bulletin of the State Weather Service for that month to have been "the heaviest rainfall and thunderstorm of the season; it was purely *local in nature* and extended only over an area of 300 square miles."

A very heavy rain in southeastern Indiana is said to have given rise to "local floods" and destruction of crops over a region about 7 miles in diameter.

A series of "local rains" on the southern coast of Florida covered a region parallel to the coast for 50 miles north and south, and from 1 to 5 miles broad east and west.

A tornado is a "local phenomenon" whose destructive winds are felt at irregular intervals over a region that may, in an extreme case, be a 100 miles long and 1 mile wide, but is more apt to be from 5 to 20 miles long and scarcely ½ of a mile wide.

A "local cloudburst" may occur in a mountain valley and over an area of scarcely ¼ of a square mile.

Is it possible to attach any definite idea to the term local? Judging from the preceding usages a West India hurricane begins as a "local whirl" in mid-Atlantic, grows into an extensive disturbance over the West Indies and our Atlantic coast, becomes a general storm in the North Atlantic, and disappears by merging into the "general circulation of the Northern Hemisphere."

The terms local and general are necessarily indefinite, and are needed for use with that understanding. But in order to give precision to our observations, it is hoped that observers will, when practicable, specify approximately the area in square miles over which any phenomenon is visible rather than content themselves with an indefinite word or usage.

WATER MEASUREMENTS FOR IRRIGATION.

The meteorologist measures the rainfall by the vertical depth of the equivalent layer of water that falls into the mouth of his gauge. Assuming that the catch of his gauge